PM53B/53C CNC System

Manufacturers' Manual

7th Edition

Weihong Electronic Technology Co., Ltd.

The information contained in this manual is constantly being updated. You can login to the official website of Weihong Company www.en.weihong.com.cn to download the latest PDF edition for free.

Preface

About This manual

This manual is intended for manufacturers. If you use the CNC system for the first time, you need to read through the manual. If you are experienced with the system, you can search for the desired info via the contents.

With 5 chapters, this manual can be divided into 4 parts, as follows:

1) Part 1: preface, introducing the precautions about transportation and storage, installation, wiring, debugging, usage, and so on. You need to read them carefully beforehand to ensure safe operations.
2) Part 2: product, including chapter 1. It consists of product overview including system configuration and introduction to interfaces.
3) Part 3: operation and application, including chapter 2, 3 and 4, which introduces wiring instruction, wiring, and machine tool debugging respectively.
4) Part 4: appendix, including chapter 5, which states the software license agreement.

Applicable Product Models

This manual is applicable to PM53B/53C control card. Refer to the table below for details:

Product Model	Remarks
PM53B/53C Control Card	Self-developed high-performance motion control card, it can be connected with stepping or servo driver with 3 channels, for supporting three axes synchronized motion. It adopts position control method and differential signal control. Pulse frequency is 160KHZ. The system boasts of protective mechanism and is a proven stable control system.

Contact Us

You can contact us by the following info for technical support and pre-sales/after-sales service:

Company Name: Weihong Electronic Technology Co., Ltd.
Headquarters Address: No.1590, Huhang Rd., Fengxian, Shanghai, PRC 201400
Tel: +86-21-33587550
Fax: +86-21-33587519
Website: http://en.weihong.com.cn

Revision History

You can refer to the following table for the revision records of each edition.

Date	Edition	Revision Contents
2016.02	R7	1) Contact information updated.
2016.01	R6	1) Wiring diagram updated in section 3.3, 3.4 and 3.5. 2) Detailed debugging step 2 and 5 updated in section 4.1. 3) Document style updated.
2015.08	R5	Including: 1) Manual hardware driver update in section 2.2; 2) Update MPG interfaces definition in section 3.2 ; 3) Update the wirings of terminals in section 3.4; 4) Machine debugging steps update in section 4 .

Precautions

Precautions can be divided into caution and warning according to the degree of possible loss or injury in case of negligence or omission of precautions stipulated in this manual.

CAUTION: general info, mainly for informing, such as supplementary instructions and conditions to enable a function. In case of negligence or omission of this kind of precautions, you may not activate a function. Note that in some circumstances, negligence or omission of even this kind of precautions could cause physical injury or machine damage.

WARNING: warning info requiring special attention. In case of negligence or omission of this kind of precautions, you may suffer physical injury, or even death, machine damage or other losses.

WARNING

1) Precautions Related to Storage and Transportation

- The products should be transported properly in terms of the weight;
- An excess of specified quantity of stacking products is prohibited;
- Climbing, standing or placing heavy loads on the products is prohibited;
- Dragging or carrying the products via cables or devices connected to them is prohibited;

WARNING

2) **Precautions Related to Installation**

- Only when this equipment installed in the qualified electricity cabinet can it be used. The construction of the cabinet must reach IP54 grade of protection;
- Paste sealing strips on the joint of the cabinet to seal all the cracks;
- Cable entry should be sealed while easy-to-open on the spot;
- A fan or heat exchanger should be adopted for the heat dissipation and air convection of the cabinet;
- If a fan is adopted, air strainer is a must in air inlet or air outlet;
- Dust or cutting fluids may have access to the CNC device via the tiny cracks and tuyere. Therefore it is necessary to pay attention to the surroundings and air flow direction of the air vent to make sure that the outflow gas is towards pollution source;
- 100 mm space should be preserved between the back of the CNC device and the cabinet wall for plugging cable connected with the device and the ventilation & heat dissipation in the cabinet;
- Space between this device and other equipments should also be preserved according to the requirements;
- The product should be installed firmly and without vibration. During installing, casting, knocking, striking, or loading on the product is forbidden;
- To reduce electromagnetic interference, power-supply components used should be above AC or DC 50V and the space between cable and CNC device should be preserved above 100mm;
- It will be better if CNC device is installed at a position facilitating debugging and maintenance.

3) **Precautions Related to Wiring**

- Only qualified people are allowed to participate in the wiring and checking;
- The CNC device should be grounded reliably and grounding resistance should be less than 4 ohm. Neutral line is absolutely not allowed to replace earth wire. Otherwise, it may result in malfunction of the device due to the interference;
- Wiring should be firm and steady, or misoperation may occur;
- Voltage values and positive & negative polarity of any connection plug should be in accordance with specifications set forth in the manual, or it may result in breakdowns such as short circuit and permanent damage to the device;
- To guard against electric shock or CNC device damage, fingers should keep dry before plugging or touching switch;
- The connecting wire should not be damaged and squeezed, or the leakage or short circuit may occur;

WARNING

- It is prohibited to plug or open the chassis of CNC device when power on.

4) **Precautions Related to Running & Debugging**

- Parameters setting should be checked before running, since wrong setting may lead to accidental movements;
- Modification to parameters should be within the allowable range, or such breakdowns as unsteady running and machine damage will occur.

5) **Precautions in Use**

- Before power-on, please make sure that the switch is on blackout to avoid occasional start-up;
- Please check the electromagnetic compatibility during electrical design in order to avoid or reduce electromagnetic interference to the CNC device. A low pass filter should be employed to reduce electromagnetic interference if there are other electrical devices nearby;
- It is not allowed to frequently power on and power off. It is recommended to power up the machine again at least one (1) minute later after power failure or blackout.

CAUTION

1) **Precautions Related to Product and Manual**

- Matters related to restrictions and functions available stipulated in the manuals issued by the machine manufacturer are prior to those in this manual;
- This manual assumes all the optional functions are available, which you must confirm through manuals issued by the machine manufacturer;
- Please refer to manuals issued by the machine manufacturer for the instructions of machine tools;
- Functions, and software interfaces vary with the system and the version of software. Before using the system, you must confirm the specifications.

2) **Precautions When Opening the Package**

- Please make sure that the products are what you have ordered;
- Check if the products are damaged in transit;
- Check if the components and accessories are damaged or missing in terms of the detailed list;
- Please contact us promptly if product discrepancy, accessory missing or transit damage occurs.

Contents

1 Overview 1

2 Installation 2

2.1 Installation Steps 2

2.2 Manually Update the Hardware Driver 2

2.3 Customized Installation Package 5

3 Wiring 6

3.1 Signal Types 6

3.1.1 Binary Input Signal 6

3.1.2 Relay Output Signal 6

3.1.3 Differential Output Signal 7

3.2 MPG Interfaces 7

3.3 Wiring Diagram of Terminal Board 9

3.4 Wiring Diagram of Terminal Board and Stepping Driver 12

3.4.1 Connection to Stepping Driver with COM Port 12

3.4.2 Connection to Differential Input Stepping Driver 12

3.5 Wiring Diagram of Terminal Board and Servo Driver 13

3.5.1 Wiring with WISE Servo Driver 13

3.5.2 Wiring with YASKAWA Σ-Ⅱ Servo Driver 13

3.5.3 Wiring Diagram of DELTA ASDA_ A/AB Servo Driver 14

3.5.4 Wiring Diagram of PANASONIC MINAS_A5 Servo Driver 15

3.5.5 Wiring Diagram of MITSUBISHI MR-E Servo Driver 15

3.5.6 Wiring Diagram of FUJI FALDIC-β Servo Driver 16

3.5.7 Wiring Diagram of STONE GS Servo Driver 16

3.6 Parameter Setting of Servo Drivers 17

3.6.1 Parameter Setting of WISE Servo Driver 17

3.6.2 Parameter Setting of YASKAWA Σ-Ⅱ Servo Driver 18

3.6.3 Parameter Setting of DELTA ASDA_ A Servo Driver 19

3.6.4 Parameter Setting of DELTA ASDA_B Servo Driver 20
3.6.5 Parameter Setting of PANASONIC MINAS_A4 Servo Driver 21
3.6.6 Parameter Setting of MITSUBISHI MR-E Servo Driver 21
3.6.7 Parameter Setting of FUJI FALDIC-β Servo Driver 22
3.6.8 Parameter Setting of STONE GS Servo Driver 23

4 Machine Tool Debugging 25

4.1 Debugging Steps 25

4.2 Pulse Test 30

5 Software License Agreement 31

1 Overview

PM53B control system consists of following components:

1) One motion control card of PM53B
2) One CD of NcStudio motion control software (not required if the software is customized)
3) One terminal board of EX23A
4) One DB37M/F cable (3m)
5) One FC16-DB15F cable (with rail block) for Manual Pulse Generator (MPG)
6) NK-MPG-05 (Optional)

PM53C control system consists of following components:

1) One motion control card of PM53C
2) One CD of NcStudio motion control software (not required if the software is customized)
3) One terminal board of EX23A
4) One DB37M/F cable (3m)

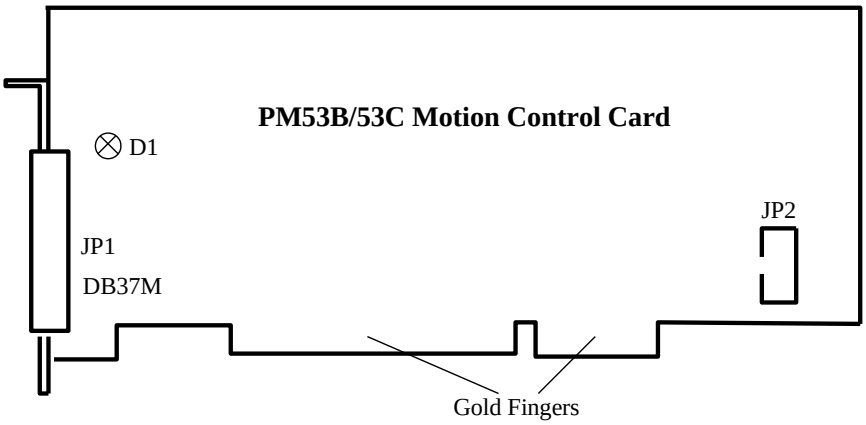


Fig. 1-1 Structural Drawing of PM53B/53C Motion Control Card

See Fig. 1-1. PM53B/53C Motion Control Card uses PCI interface.

The size of PM53B control card is 165mm* 120mm. The Control Card has 2 sockets: JP1 is the DB37M socket for the connection of control signals, and connected to the EX23A terminal board with the cable DB37M/F. JP2 is the socket for Manual Pulse Generator (MPG) and connected to the back of the host computer with the cable FC16-DB15F (with rail block).

The size of PM53C control card is 156mm* 96mm, with only one socket, JP1, which is DB37M socket for the connection of control signals, and connected to the EX23A terminal board with cable DB37M/F.

CAUTION

There is a red LED D1 on each motion control card, which indicates their work status. When NcStudio runs normally, D1 is off or it glows.

2 Installation

2.1 Installation Steps

1) Insert the software NcStudio CD to the CD driver of computer, and then double click the icon  for installation of the software;
2) Power off the computer, then open the chassis of host computer, then insert the control card to a PCI slot and then fasten the rail block screw (if there is an extended flat cable, its rail block should also be fixed), and then well cover the host computer chassis;
3) Power on the computer. The computer will find the new hardware-device and install its driver automatically;
4) Double click the shortcut icon of NcStudio on the desktop; if it runs normally, installation is over. (If the control system runs abnormally, please check whether the control card is well inserted and whether the gold finger is clean)

2.2 Manually Update the Hardware Driver

1) Right click “My Computer”, select “Properties”, and then click “Device Manager”. Choose the “CNC Adaptor” item, right click on it and select “Update Driver Software…” Users can begin updating process according to the wizard. A dialog box as Fig. 2-1 will pop up.

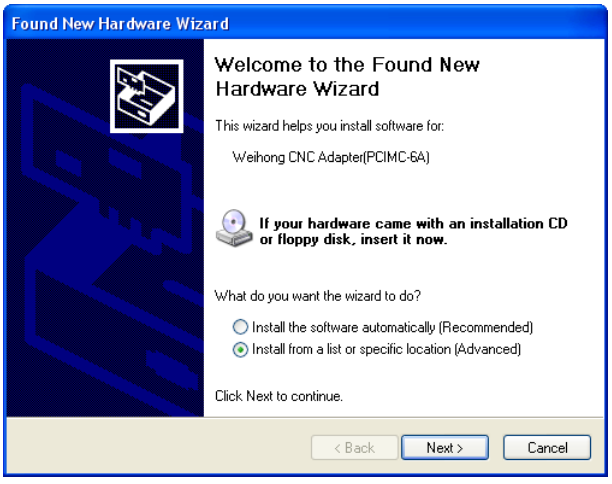


Fig. 2-1 Hardware update wizard

2) Select “Install form a list of specific location (Advanced)”, click [Next] to continue. A dialog box as Fig. 2-2 will pop up.

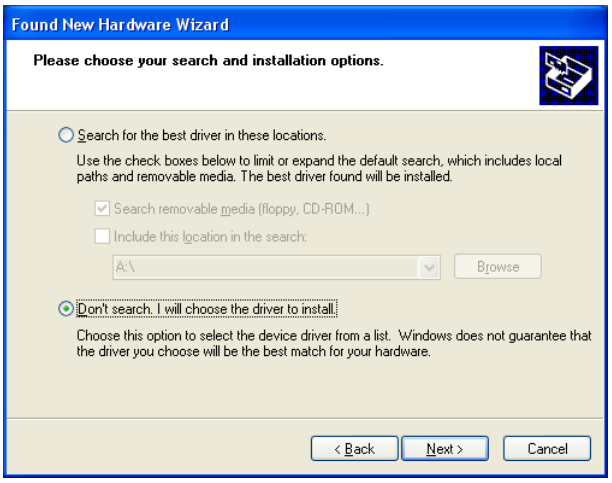


Fig. 2-2 Choose search and installation option

3) Select “Don’t search, I will choose the driver to install”, click [Next] to continue. A dialog box containing compatible hardware will pop up, as shown in Fig. 2-3,

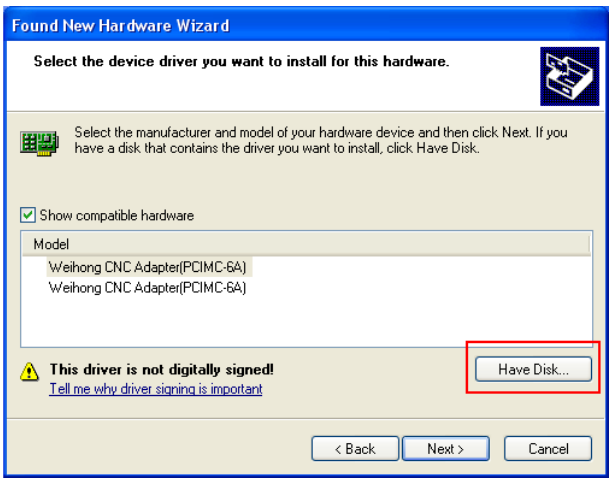


Fig. 2-3 Select the driver manually

4) Click [Have Disk...] button to open the next dialog box. A dialog box named “Install From Disk” will pop up, as shown in Fig. 2-4.

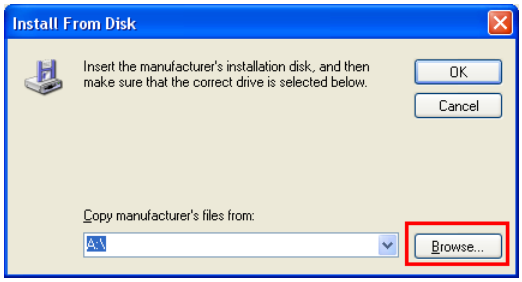


Fig. 2-4 Select the target file of driver

5) Click “Browse” to open a dialog box named “Locate File”, as shown in Fig. 2-5, select the target hardware driver in the list. Choose the target file “NcadptPci(PCIMC-6A).inf” under the directory of *C:\ProgramFiles\Naiky\PCIMC-6A.*

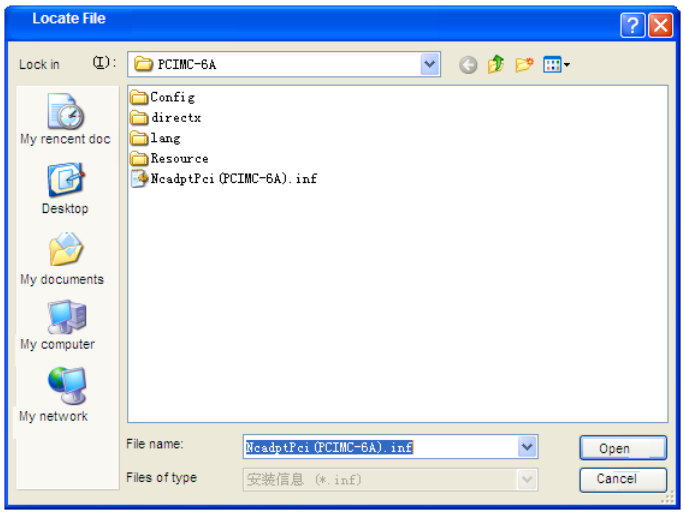


Fig. 2-5 Select the hardware driver

6) After hardware driver being correctly chosen, the interface jumps to the previous dialog box where the target file directory will be displayed under item “Copy manufacturer’s files from:”, as shown in Fig. 2-6.

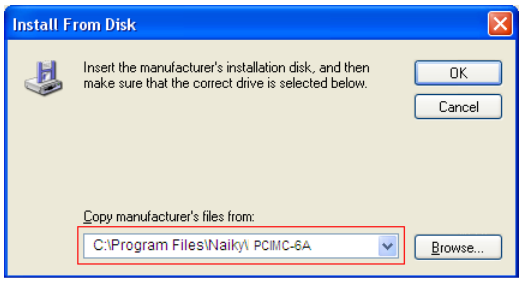


Fig. 2-6 Target file directory confirmation

7) Click [OK] to go back, and then click [Next] to start updating the driver software. The progressing picture is shown as Fig. 2-7.

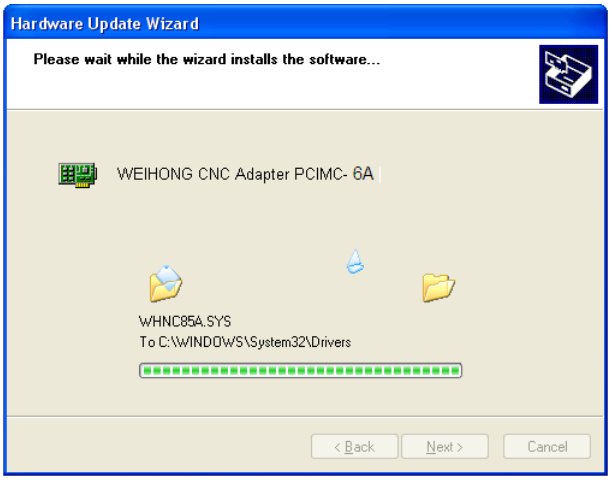


Fig. 2-7 Updating the driver

8) When the updating is finished, a dialog as shown in Fig. 2-8 will pop up. Click [Finish] to complete the update of the hardware driver.

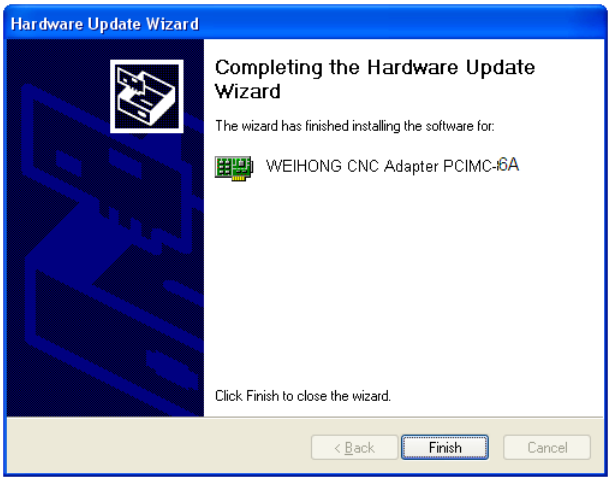


Fig. 2-8 Driver update completed

2.3 Customized Installation Package

A tool, named NcHelper.exe under the installation directory, helps customize setup installation package. For example, when you want to change the settings of some parameters and set them to default value in the process of using NcStudio, to achieve the best performance of a machine tool, you can change the settings, find this tool, double click it, select a default configuration, and generate a new software package with the parameter settings changed.

3 Wiring

3.1 Signal Types

3.1.1 Binary Input Signal

Binary input signal is active low; it supports NO (Normally Open) and NC (Normally Closed) input signals (by modifying the polarity of input ports in the software). When using a NO switch, the signal is available as connecting with COM; when using a NC switch, the signal is available as disconnecting with COM.

When the mechanical switch connects with binary input signal, one end of the mechanical switch connects to the binary input port and the other end to GND, as shown in Fig. 3-1:

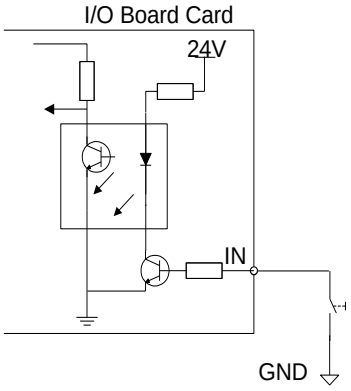


Fig. 3-1 Connection between Mechanical Switch and Binary Input Signal

The binary input signal can also be connected with a photoelectric switch or proximity switch of NPN (NO) or NPN (NC) type. The connection diagram is shown below in Fig. 3-2:

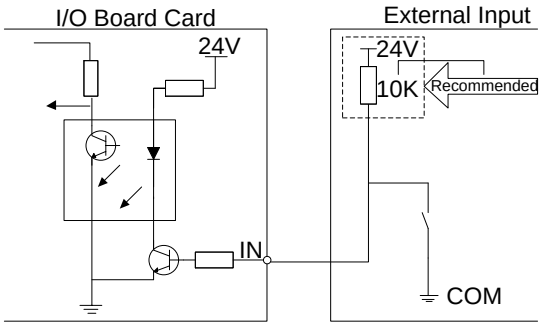


Fig. 3-2 Connection between Binary Input Signal and Photoelectric Switch (or Proximity Switch)

3.1.2 Relay Output Signal

The relay output contact points on the terminal board have load capacity: 10A/250VAC and

10A/30VDC, which can control 220V AC load of low power. If high power load is needed, a contactor can be used. See Fig. 3-3 for the connection.

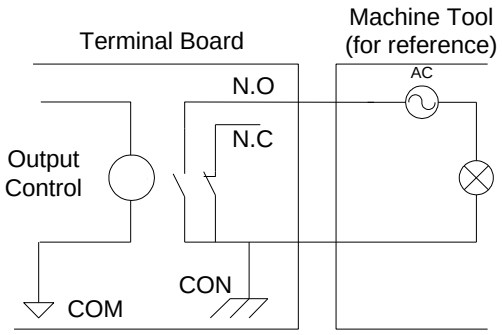


Fig. 3-3 Connection between Contactor and Relay Output

3.1.3 Differential Output Signal

Pulse command form: pulse plus direction, negative logic. The maximum pulse frequency: 160KHZ. The sketch map of pulse mode is shown below in Fig. 3-4:

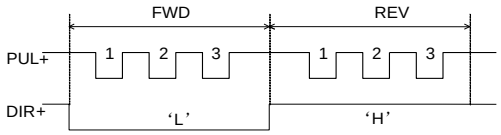


Fig. 3-4 Type of Pulse Command Output

Output mode of differential signal is shown as below in Fig. 3-5:

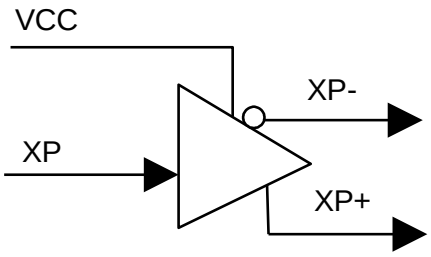


Fig. 3-5 Output Circuit of Pulse Command

3.2 MPG Interfaces

JP2 interface on PM53B motion control card is used for connection with handwheel, or MPG, via a FC16-DB15F connector. Please note that handwheel is an optional component, and the pins definition for interfaces of handwheel developed by Weihong Company is illustrated as below:

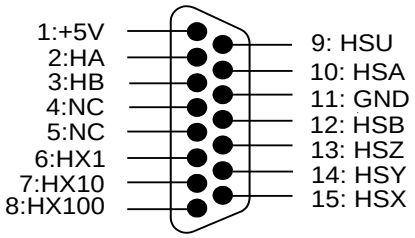


Fig. 3-6 Pins definition of MPG interfaces

- **See table 1 for specific pin definition of the MPG interfaces.**

Table 1 pin definition of the MPG interfaces

Pins No.	Definition	Description
1	+5V	Power on handwheel
2	HA	Encoder phase A signal
3	HB	Encoder phase B signal
4	NC	-
5	NC	-
6	HX1	X1 override
7	HX10	X10 override
8	HX100	X100 override
9	HSU	Selection of the fourth axis
10	HSA	Selection of the fifth axis
11	GND	Digital ground
12	HSB	Selection of the sixth axis
13	HSZ	Selection of Z axis
14	HSY	Selection of Y axis
15	HSX	Selection of X axis

3.3 Wiring Diagram of Terminal Board

◆ **Terminal Board EX23A**

See Fig. 3-7 for the wiring diagram of the terminal board EX23A (154mm*72mm), for standard XYZ axes configuration for engraving machines.

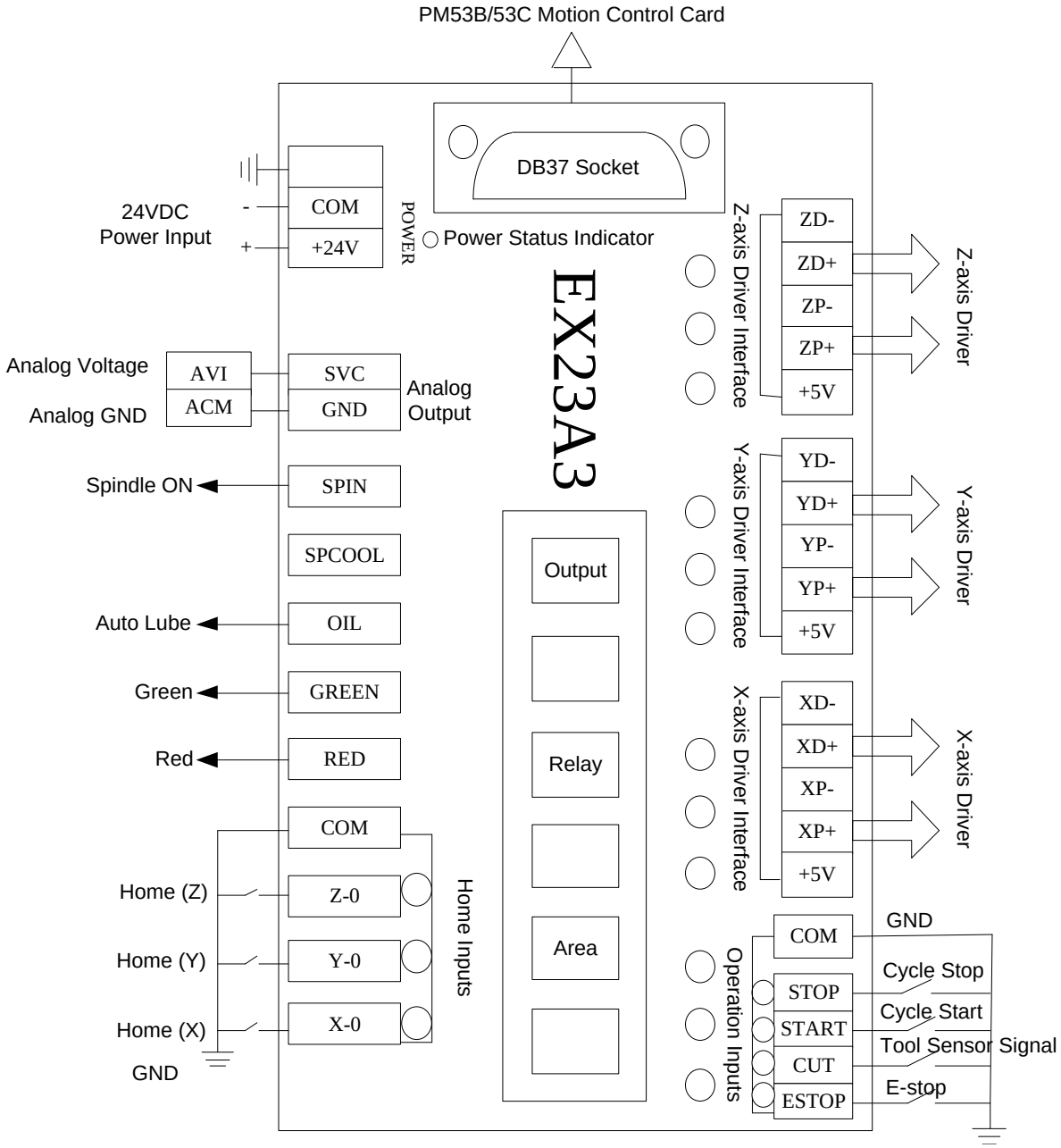


Fig. 3-7 Wiring Diagram of Terminal Board EX23A

◆ Terminal Board 6B-EX4A

See Fig. 3-8 for the wiring diagram of the terminal board 6B-EX4A (295mm*76mm).

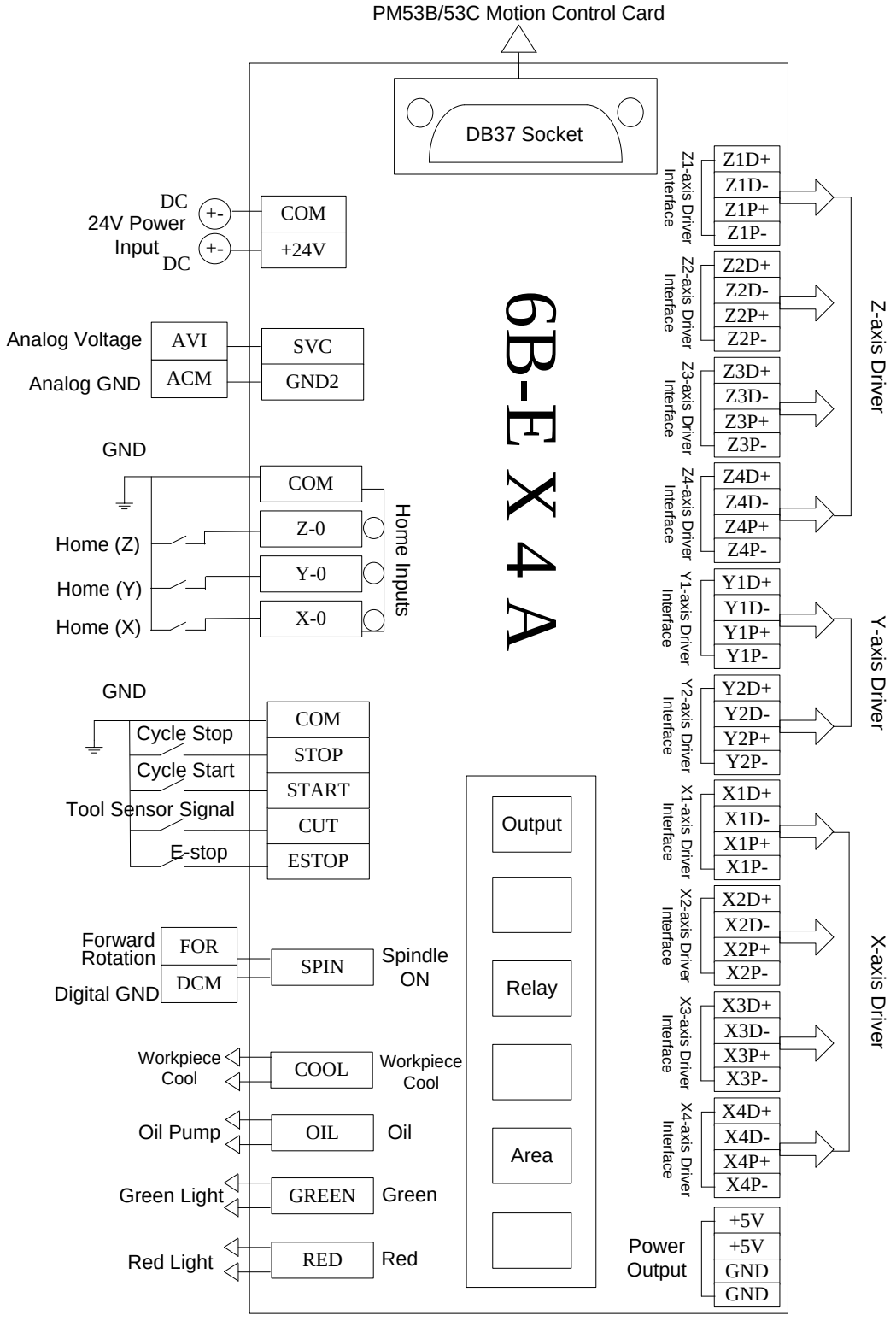


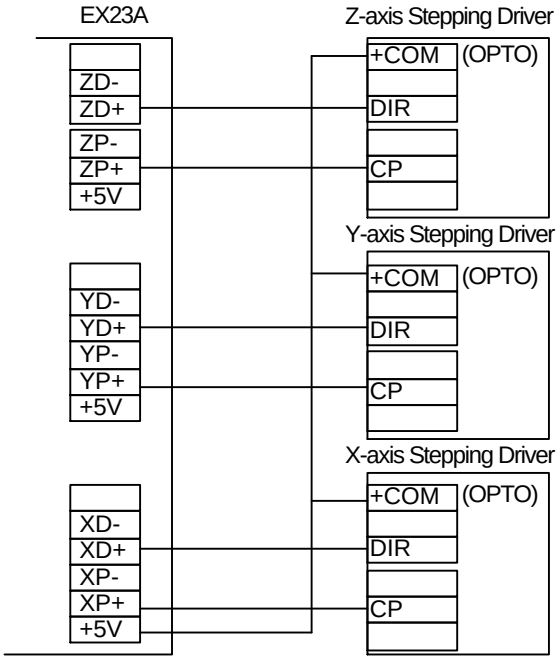
Fig. 3-8 Wiring Diagram of Terminal Board 6B-EX4A

Table 2 pins definition of terminal board.

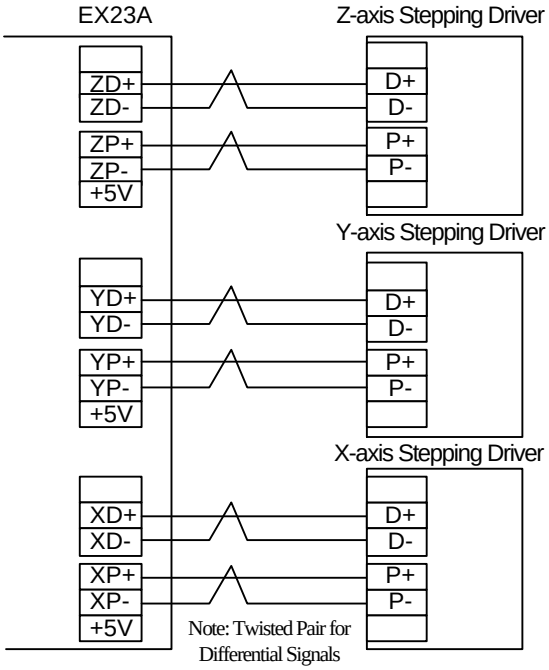
Printed name	Signal Descriptions	Remarks
24V	DC 24V power signal	Voltage 24DC, electric current 3A or above. All port of 24V on the terminal board are inter-connected.
COM	Common port signal	All COM ports on the terminal board are inter-connected.
ESTOP	Emergency stop signal	Binary input, generally connected to a NC (normally closed) button. Disconnection with COM port makes the system stop immediately.
CUT	Tool sensor signal	Binary input, connected to a tool sensor.
START	Cycle starts signal	Cycle starts.
STOP	Cycle stops signal	Cycle stops.
Z0	Reference point signal of Z axis	Binary input, active low, connected to Z axis home switch.
Y0	Reference point signal of Y axis	Binary input, active low, connected to Y axis home switch.
X0	Reference point signal of X axis	Binary input, active low, connected to X axis home switch.
GREEN	Green working light signal	Green light on when machine works normally.
RED	Red alarm light signal	Red light on when system E-stop occurs, or cycle ends regularly.
OIL	Auto lubrication signal	Relay contact output, controlling auto lubrication. LED light on when lube is filling, and off when lube stops filling.
SPIN	Spindle starts rotating signal	Relay output, two terminals are respectively connected to ground (DCM) and inverter forward rotation port (FOR port generally).
COOL	Workpiece cooling signal	Relay contact output. Two terminals work as a switch, controlling spindle coolant on/off.

3.4 Wiring Diagram of Terminal Board and Stepping Driver

3.4.1 Connection to Stepping Driver with COM Port

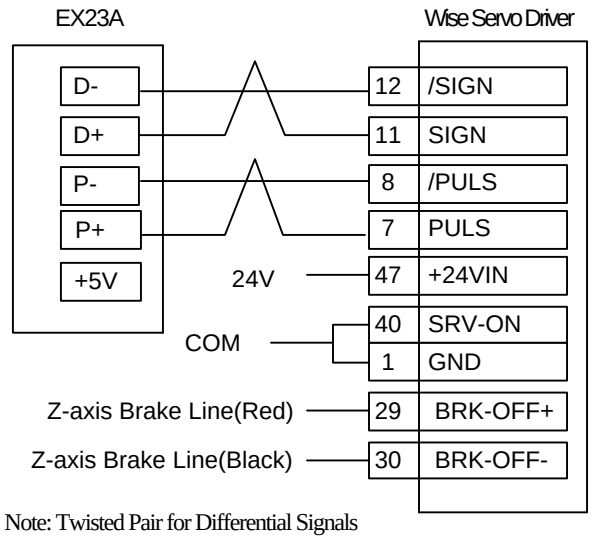


3.4.2 Connection to Differential Input Stepping Driver



3.5 Wiring Diagram of Terminal Board and Servo Driver

3.5.1 Wiring with WISE Servo Driver

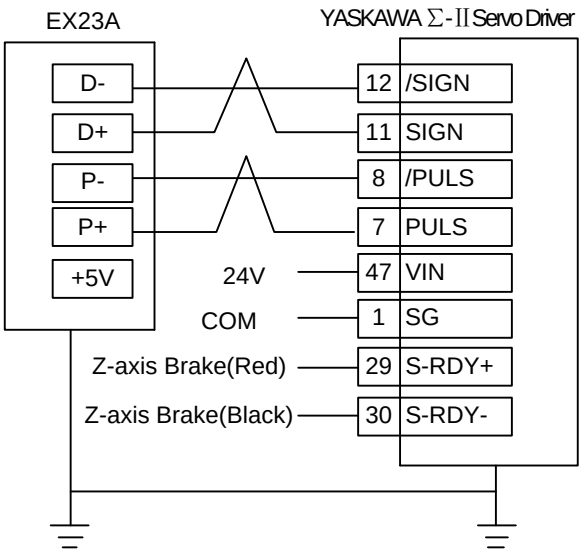


Note: Twisted Pair for Differential Signals

CAUTION

Wirings of X, Y and Z axis are the same, except that two Z-axis brake lines can connect to relay to control brakes.

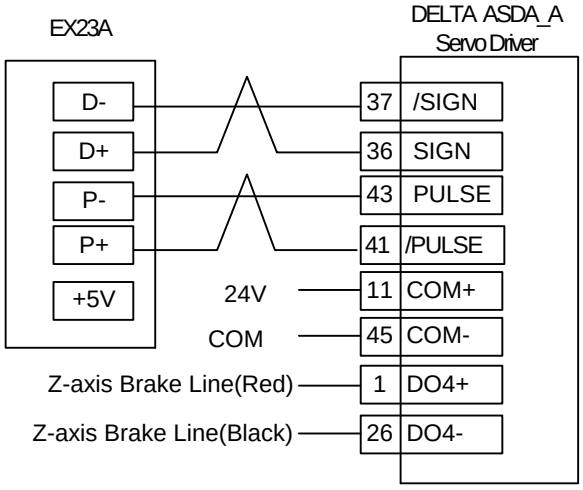
3.5.2 Wiring with YASKAWA Σ-Ⅱ Servo Driver

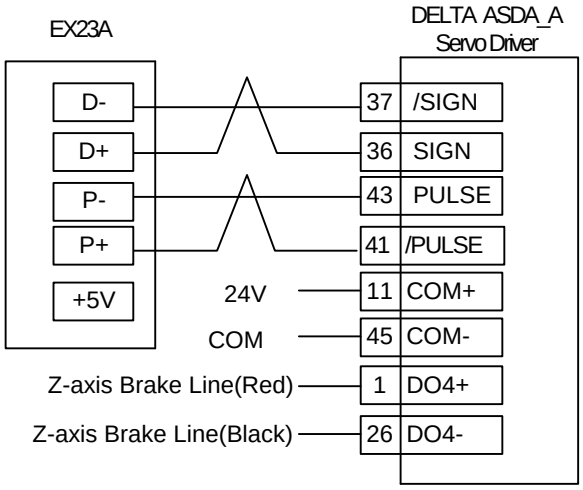


CAUTION

Wirings of X, Y and Z axis are the same, except that two Z-axis brake lines can connect to relay to control brakes.

3.5.3 Wiring Diagram of DELTA ASDA_ A/AB Servo Driver

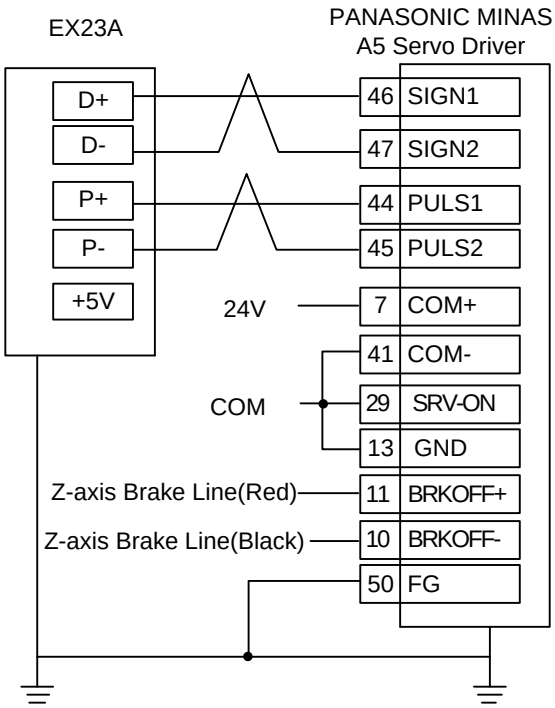




CAUTION

Wirings of X, Y and Z axis are the same, except that two Z-axis brake lines can connect to relay to control brakes.

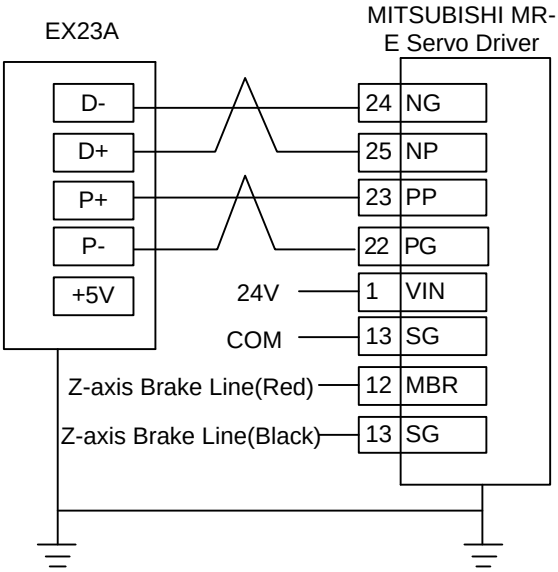
3.5.4 Wiring Diagram of PANASONIC MINAS_A5 Servo Driver



CAUTION

Wirings of X, Y and Z axis are the same, except that two Z-axis brake lines can connect to relay to control brakes.

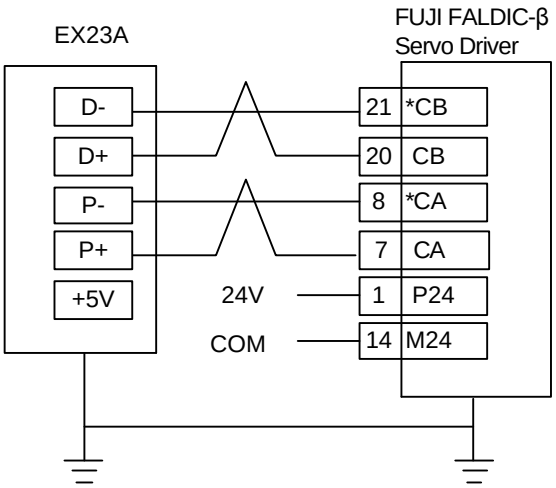
3.5.5 Wiring Diagram of MITSUBISHI MR-E Servo Driver



CAUTION

Wirings of X, Y and Z axis are the same, except that two Z-axis brake lines can connect to relay to control brakes.

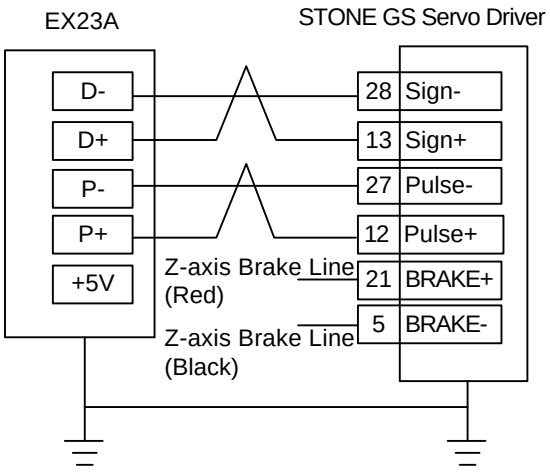
3.5.6 Wiring Diagram of FUJI FALDIC-β Servo Driver



CAUTION

Wirings of X axis, Y axis, and Z axis are the same, and the brake of Z axis is internally controlled.

3.5.7 Wiring Diagram of STONE GS Servo Driver



CAUTION

Wirings of X, Y and Z axis are the same, except that two Z-axis brake lines can connect to relay to control brakes.

3.6 Parameter Setting of Servo Drivers

3.6.1 Parameter Setting of WISE Servo Driver

Para. No.	Function	Setting Value	Description
Pr528	LED initial status	6	Monitor if the number of sent and received pulses is correct by setting this parameter. In Weihong control system, the correct quantity of pulses sent by control card is detected by pulse inspection in order to determine whether there is electrical interference.
Pr008	Command pulse No. per motor circle	0	When it is set to “0”, parameters Pr009 and Pr010 are valid.
Pr009	1st numerator of command pulse frequency division/ multiplication	To be calculated	Range: 0~2^{30} Typical value: pitch 5 mm, encoder resolution 10000, deceleration ratio 1:1, pulse equivalent 0.001 mm: Pr009＝10000 Pr010＝pitch 5mm/ pulse equivalent 0.001mm＝5000 Pr009/Pr010=10000/5000=2/1
Pr010	Denominator of command pulse frequency division/multiplication	To be calculated	
Pr100	1st position loop gain	480 (default)	Unit: 0.1/s. Set it according to the actual situation.
Pr101	1st velocity loop gain	270 (default)	Unit: 0.1Hz. Set it according to the actual situation.
Pr102	1st velocity loop integrated time constant	210 (default)	Unit: 0.1ms. Set it according to the actual situation.
When the value of Pr008 is not “0”, it can be calculated in terms of the following formula: $\text{Command pulse No. per motor circle} = \frac{\text{Screw pitch}}{\text{Pulse equivalent} \times \text{Mechanical deceleration ratio}} = \frac{5\text{mm}}{0.001\text{mm}/p} = 5000$ When screw pitch is 5mm and pulse equivalent 0.001, the value of Pr008 is “5000”.			

- **Attached Table: relationship among parameters Pr008, Pr009 and Pr010**

Pr008	Pr009	Pr010	Description
0~2^{20}	_ (no influence)	_ (no influence)	Command Pulse Input → Encoder Resolution / Setting Value of Pr008 → Position Command As shown above, the process is undergone in terms of the setting value of Pr008, not affected by the settings of Pr009 and Pr010.

Pr008	Pr009	Pr010	Description
0	0	0~2^{30}	Command Pulse Input → Encoder Resolution / Setting Value of Pr010 → Position Command When the values of Pr008 and Pr009 are both set to “0”, as shown above, the process is undergone in terms of the setting value of Pr010.
	0~2^{30}	0~2^{30}	Command Pulse Input → Setting Value of Pr009 / Setting Value of Pr010 → Position Command When the value of Pr008 is “0”, but the value of Pr009 is not “0”, as shown above, the process is undergone in terms of the setting values of Pr009 and Pr010.

3.6.2 Parameter Setting of YASKAWA Σ-Ⅱ Servo Driver

Para. No.	Function	Setting Value	Description		
UN00C	Monitor mode	LXXXX (Hexadecimal system)	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference.		
Pn000	Direction selection Control method selection	0010	Bit 0: Set 0, “CCW” is forward rotation (viewed from the load end of screw ball); Set 1, the rotation direction of the motor is reversed. Bit 1: Set 1, position control mode (calculate pulse instruction all the time).		
Pn001	Selection servo off or alarm stop mode	XXX0	Bit 0: Set ”0”, stopping the motor by applying dynamic brake(DB) which will be maintained after stop; Set ”1”, stopping the motor by applying dynamic brake(DB) and then motor can rotate freely after stop.		
Pn200	Selection pulse mode	0005	Bit 0: Set “5”, select instruction mode as “pulse + direction”, negative logic. Bit3: Set “0”, input differential signal into filter.		
Pn201	Encoder cycle-divide ratio (Pulse output No. per motor cycle by	Right-side	Gain encoder	Model	No. of pulse per revolution(P/R)
				A	13bit 2048
				B	16bit 16384

Para. No.	Function	Setting Value	Description		
	encoder after cycle divided)			C	17bit 32768
Pn202	Numerator of Electronic Gear Ratio	To be calculated	Pn202 = pulse number of each encoder circle × 4 × mechanical deceleration ratio Pn203 = (screw pitch / pulse equivalent) Typical value: pitch 5mm, encoder 17-bit, deceleration ratio 1:1, pulse equivalent 0.001mm, Pn202＝16384; Pn203＝625. pitch 5mm, encoder 17-bit, deceleration ratio 1:1, pulse equivalent 0.0005mm, Pn202＝8192; Pn203＝625		
Pn203	Denominator of Electronic Gear Ratio	To be calculated			

3.6.3 Parameter Setting of DELTA ASDA_ A Servo Driver

Para. No.	Function	Format & Range	Value	Description
P0-02	Driver Status display		02	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection to determine if there is electrical interference.
P1-00	External pulse input type	ZYX	102	X=2: pulse + direction; Z=1: negative logic
P1-01	Set control mode	ZYX1X0	0000	Z=0: when switching control mode, DIO is maintaining the set value. Since switching control mode is not used, Z=0 Y=0: forward rotation (anticlockwise) (from the point of load); Y=1: the rotation direction is reversed. X1X0=00: position control mode
P1-44	Numerator of Electronic Gear Ratio, (N1)	1~32767	To be calculated	N1 / M= encoder pulses× 4× pulse equivalent× mechanical deceleration ratio / pitch. Representative value: encoder pulses 2500, pulse equivalent 0.001, pitch 5mm, mechanical deceleration ratio 1, calculation as below: N1 / M= 2500×4×0.001/5 = 2 / 1, N1=2, M=1; When the multi-electronic gear ratio is not used, P2-60~ P2-62 are not required.
P1-45	Denominator of Electronic Gear Ratio, (M)	1~32767	To be calculated	
P2-51	Servo ON setting		0	0: Servo ON must be triggered by numerical input signal.

Para. No.	Function	Format & Range	Value	Description
				1: when servo powered, if there is no alarm signal, servo will be automatically on. Set 1 when there is no SON signal wire.

3.6.4 Parameter Setting of DELTA ASDA_B Servo Driver

Para. No.	Function	Format & Range	Value	Description
P0-02	Driver Status display		02	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference.
P1-00	External pulse input type	ZYX	102	X=2: pulse + direction; Z=1: negative logic
P1-01	Set control mode	YX1X0	000	Y=0: forward rotation (anticlockwise) (from the view of load); Y=1: the rotation direction is reversed. X1X0=00: position control mode
P1-32	Motor stop mode	YX	00	Y=0: when there is no servo enabled, motor dynamic brake occurs; Y=1: motor is free. X=0: motor stops instantly, X=1: motor stops with deceleration.
P1-44	Numerator of Electronic Gear Ratio, (N1)	1~32767	To be calculated	N1 / M= encoder pulses× 4× pulse equivalent× mechanical deceleration ratio / pitch. Representative value: encoder pulses 2500, pulse equivalent 0.001 mm/p, pitch 5mm, mechanical deceleration ratio 1, calculation as below: N1 / M = 2500×4×0.001/5 = 2/1, N1=2, M=1; When the multi-electronic gear ratio is not used, P2-60 ~P2-62 are not required.
P1-45	Denominator of Electronic Gear Ratio, (M)	1~32767	To be calculated	
P2-30	Servo ON SON setup		0	0: Servo ON must be triggered by signal of digital input; 1: when servo is powered on, if there is no alarming, servo will be auto ON. When there is no SON signal wire, set the value as 1.

3.6.5 Parameter Setting of PANASONIC MINAS_A4 Servo Driver

Para. No.	Function	Value	Description
Pr01	LED initial status	12	Monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection in order to determine whether there is electrical interference.
Pr02	Select control mode	0	0: position mode 1: velocity mode 2: torque mode
Pr40	Selection of command pulse input	1	1: input through exclusive difference circuit
Pr42	Select command pulse input mode	3	Set command pulse input mode: pulse + direction, negative logic
Pr48	Numerator of the first pulse command frequency multiplication	To be calculated Range: 1~10000	Typical values: pitch 5 mm, encoder resolution 10000, deceleration ratio 1:1, pulse equivalent 0.001 mm: Pr48＝10000 Pr4B＝pitch 5mm / pulse equivalent 0.001mm＝5000 Pr48 / Pr4B=10000 / 5000=2/1
Pr4B	Denominator of the command pulse frequency multiplication	To be calculated Range: 1~10000	

3.6.6 Parameter Setting of MITSUBISHI MR-E Servo Driver

Para. No.	Code	Function	Value	Description
0	*STY	Control mode selection and regenerative fittings	X0X0	Bit 0: set 0: select position control mode. Bit 1, select motor series: 0: HC-KFE; 1:HC-SFE. Bit 3, select regenerative apparatus, set 0: not use. Bit 4, select motor power.
3	CMX	Numerator of Electronic Gear Ratio	To be calculated	CMX / CDV= command unit × servo motor resolution × mechanical deceleration ratio / screw pitch E.G., pitch 5 mm, encoder resolution 10000,
4	CDV	Denominator	To be	

Para. No.	Code	Function	Value	Description
		of Electronic Gear Ratio	calculated	deceleration ratio 1:1, pulse equivalent 0.001 mm, CMX/CDV=10000×0.001/5 = 2/1; When pulse unit = 0.0005mm, CMX / CDV = 1/1. Electronic gear ratio range: 1/50 ~ 500
18	*DMD	Status display selection	00XX	3: cumulative command pulses E: load inertia When the parameter is set [3], monitor if the number of sent and received pulse is correct by setting this parameter. In Weihong control system, the correct quantity of pulse sent by control card is detected by pulse inspection to determine if there is electrical interference.
21	*OP3	Function selection 3 (command pulse format selection)	0001	Set pulse command input form: pulse train + sign, negative logic
41	*DIA	Signal input SON-ON, LSP-ON and LSN-ON automatically selection	0110	Bit 0: Servo-ON selection. [0]: servo on by external input; [1]: servo on all the time inside. Bit 1: last signal of positive rotation range (LSP): [1]: auto servo on inside and no need of external wiring. Bit 3: last signal of negative rotation range (LSN) : [1]: auto servo on inside and no need of external wiring.

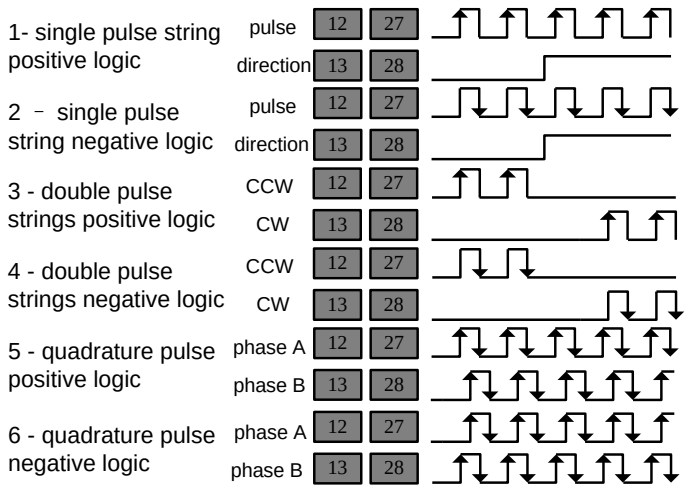
3.6.7 Parameter Setting of FUJI FALDIC-β Servo Driver

Para. No.	Name	Value	Description
01	Command pulse numerator α	To be calculated 1~32767	Command pulse numerator and denominator are also those of the electronic gear ratio. α / β=encoder resolution× pulse equivalent× mechanical deceleration ratio / screw pitch. Typical value: encoder resolution 65536, pulse equivalent 0.001, pitch 5mm, mechanical deceleration ratio 1, α / β=65536×0.001 / 5=8192 / 625, So α=8192, β=625.
02	Command pulse denominator β	To be calculated 1~32767	

Para. No.	Name	Value	Description
03	Pulse string input form	0	Set the input mode of pulse string as: instruction + symbol, that is 'pulse + direction'.
04	Direction of rotation switch	0 or 1	Set 0: Positive direction: Forward rotation (CCW); Set 1: Positive direction: Reverse rotation (CW).
10	CONT1 signal distribution	1	CONT1 is distributed as RUN (that is SON); if not distributed, CONT1 will be auto ON if there is no alarming when powered.
11	CONT2 signal distribution	2	CONT2 is distributed as RST (that is servo alarming clearance CLR). When parameters 12, 13 and 14 are 0, that is CONT3, CONT4 and CONT5 can't be distributed as OT over-travel or EMG (exterior emergency stop).
15	OUT1 signal distribution	1	Set 1, OUT1 is distributed as a-contact point of alarming output; Set 2, OUT1 is distributed as b-contact point of alarming detection.
27	Parameter write-protecti on	0 or 1	Set 0, write-enable. Set 1, write-protected.

3.6.8 Parameter Setting of STONE GS Servo Driver

Para. No.	Parameter Name	Value	Description
F0f	Numerator of Electronic Gear Ratio	2	Electronic gear ratio of position mode: 4 × pulse frequency fed back by servo encoder = command pulse frequency × F0f / F10; Value of F0f / F10 must be within 1/100~100. (calculation with pitch 10mm)
F10	Denominator of Electronic Gear Ratio	1	
F00	Control mode selection	2	0: External speed running mode; setting the value and direction of motor velocity according to the external analog －10V~+10V signal of CN2-16, 17; 1: Internal speed running mode; setting the value and direction of motor velocity according to the setting of parameter F33, F35, F37, F39 and the port status of CN2-9, CN2-25; 2: Position pulse running mode; accepting the input of external position pulse and direction level signal; 3: Jog mode; make sure the motor speed in terms of parameter

<table>
<tr><th>Para. No.</th><th>Parameter Name</th><th>Value</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td>setting of F3b, and control the rotation direction by the direction keystroke ▼ and ▲;
4: Torque mode; setting the value and direction of motor torque according to the external analog －10V~+10V signal of CN2-43, 1;
5 ~ 10: Mixed mode; selecting mode according to the port input status of CN2-24:
<table>
<tr><th rowspan="2">F00 Value</th><th colspan="2">CN2-24 Interface Status</th></tr>
<tr><th>OFF (Mode One)</th><th>ON (Mode Two)</th></tr>
<tr><td>5</td><td>Position Pulse Mode</td><td>External Speed Running Mode</td></tr>
<tr><td>6</td><td>Position Pulse Mode</td><td>Internal Speed Running Mode</td></tr>
<tr><td>7</td><td>Position Pulse Mode</td><td>Torque Mode</td></tr>
<tr><td>8</td><td>Internal Speed Running Mode</td><td>External Speed Running Mode</td></tr>
<tr><td>9</td><td>Internal Speed Running Mode</td><td>Torque Mode</td></tr>
<tr><td>10</td><td>External Speed Running Mode</td><td>Torque Mode</td></tr>
</table></td></tr>
<tr><td>F2e</td><td>Pulse input mode selection</td><td>2</td><td>Command pulse string mode selection of position mode:
 
</td></tr>
</table>

4 Machine Tool Debugging

4.1 Debugging Steps

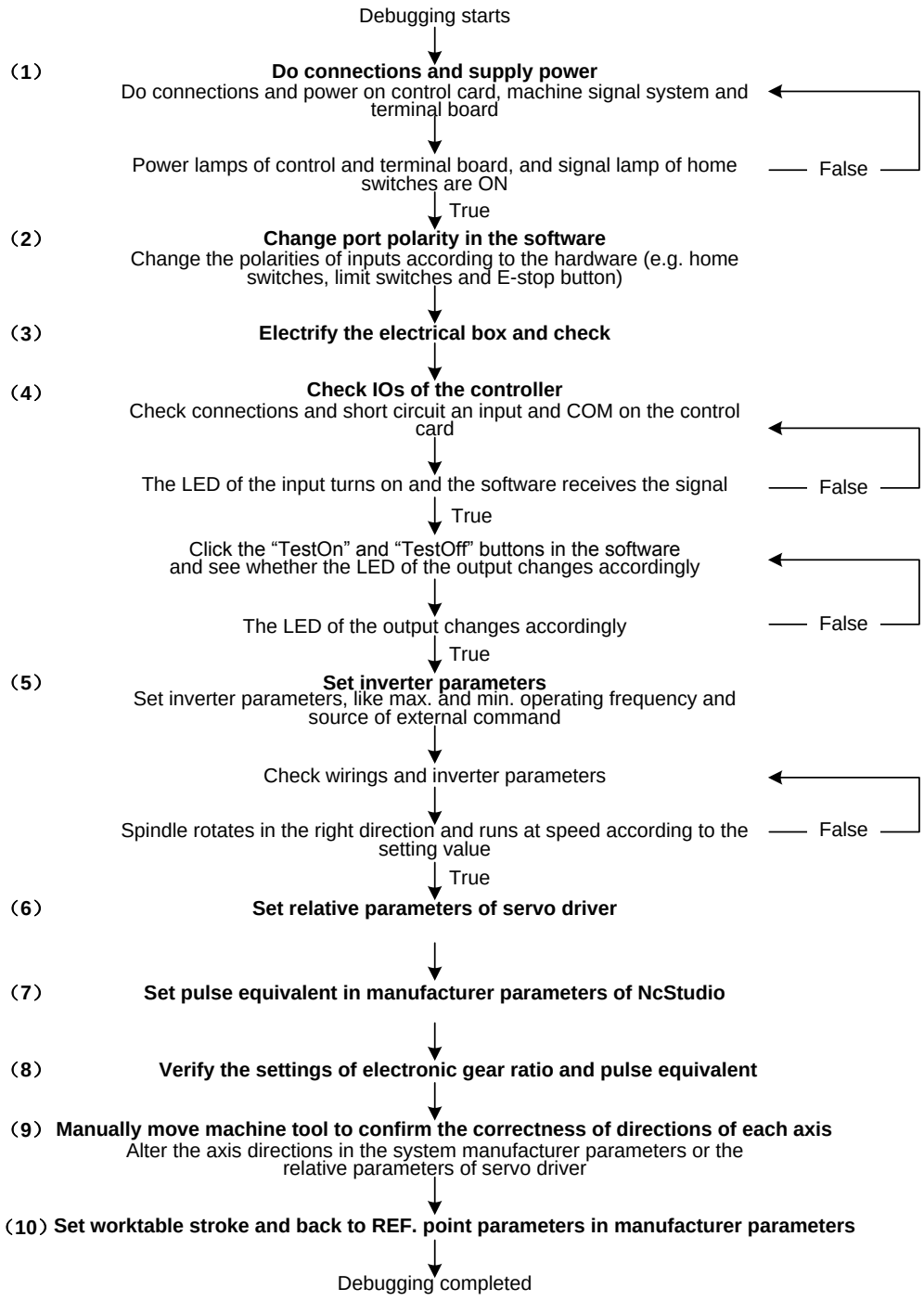


Fig. 4-1 Process of machine tool debugging steps

The above process is for preliminary debugging, see below for detailed steps:

1) Join the terminal board to port JP1 on the control card with DB37M/F cable, provide 24V power

supply for the terminal board, and power on the machine signal system (proximity switch, etc). Examine the input signal LEDs of the terminal board: for example, if the home switches connected are normally closed, at this time, three LEDs of X0, Y0 and Z0 should be on, trigger a home switch through artificial imitation. (For a travel switch, artificial press can be used to observe whether the signals can be received. For a photoelectrical switch, artificially obstruct the light to see if the signals can be gotten. For a metal proximity switch, artificially approach it with a metal block to see if the signals can be gotten.) If the corresponding LED is out, it indicates the REF. point signals have been sent to the terminal board. If the home switches connected are normally open, LEDs should be usually out, and by artificially touching a switch, the LED should become light, which shows the REF. point signals have been sent to the terminal board. The same method can be taken to test other input ports to ensure the correctness of the wiring between the terminal board and the machine tool, to greatly shorten the debugging time.

2) Power on the computer and run NcStudio, and then switch to interface [I/O State] in NcStudio V8 as shown in Fig. 4-2, or to [IOPort] interface in NcStudio V9 as shown in Fig. 4-3. The screenshots are for reference only. Input and output signals are displayed in the interfaces. Ports displayed vary with software version and hardware (terminal board). The actual situation is in line with shipment. Solid dots represent input signals, while hollow dots output signals; dots in red indicate the signals are invalid at the time (with no input or output), while dots in green indicate the signals are valid at the time.

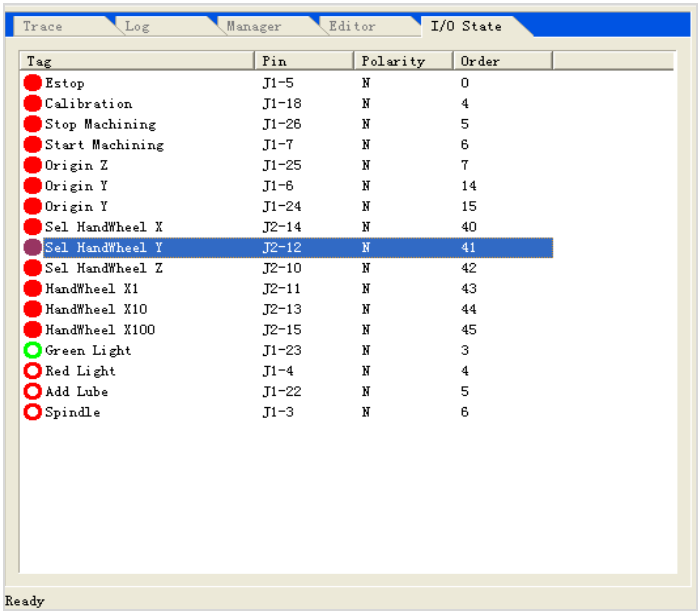


Fig. 4-2 [I/O State] Interface in NcStudio V8

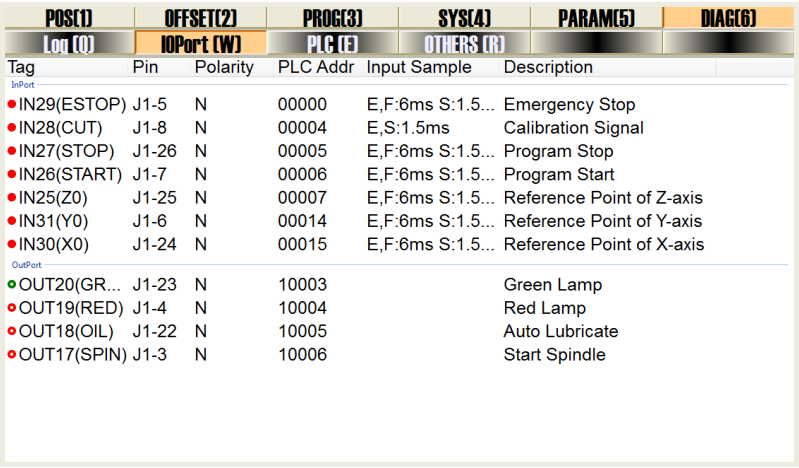


Fig. 4-3 [IOPort] Interface in NcStudio V9

3) Alter the input port polarity of the software in terms of the home switches and E-STOP button used: the polarity of NO input ports is N, while that of NC input ports is P. The way to alter the polarity is as follows:

   a) In NcStudio V8: press Ctrl, Alt and Shift simultaneously, while right clicking the signal to modify its polarity, a menu to appear, and then choose “Toggle Polarity”. After changing the polarity of all desired ports, close and restart NcStudio, polarity modification to become valid instantly.

   b) In NcStudio V9: directly click the manipulation button [ConvtPol], or press its shortcut key F5 under [IO Port] screen of [DIAG] function tab. After changing the polarity of all desired ports, close and restart NcStudio, polarity modification to become valid instantly.

4) Electrify the electrical box. At this time, the dots in front of such input signals as REF. point signals of the three axes, E-STOP signal, cycle start/stop signals and tool sensor signal should be in red, indicating all these signals are invalid. Otherwise, it is necessary to check the correctness of electrical circuitry and signals polarity. If electrical circuitry is correct, alter the corresponding signal polarity to ensure the dots in front of the above-mentioned signals red.

5) Test whether the inputs and outputs on the terminal board work normally. For an input, the method is as following: short circuit an input and COM on the terminal board: if the corresponding LED on the terminal board turns on, but the corresponding input in the software does not have the signal, you need to check the connection of the cable DB37M/F between the control card and the terminal board. If the LED does not turn on, you need to check whether the terminal board meets a fault (like power supply issue). To test an output port, set parameter “Move to Mechanic Point before Machining” as “False”. Enter a command in interface [MDI] after selecting sub-menu [Advanced MDI] under menu [Operation] in NcStudio V8, as shown in Fig. 4-4, or in interface [UserCom] in NcStudio V9, as shown in Fig. 4-5. Use 901 command to program the command, for example command “M901 H2 P1/M901 H2 P0” is for testing port 2. After executing the command you inputted, observe whether the corresponding LED on the terminal board turns on or off accordingly. If so, the output works normally; if not, check the connection of the cable DB37M/F between the control card and the terminal board. And if the connection is correct, you need to change a terminal board.

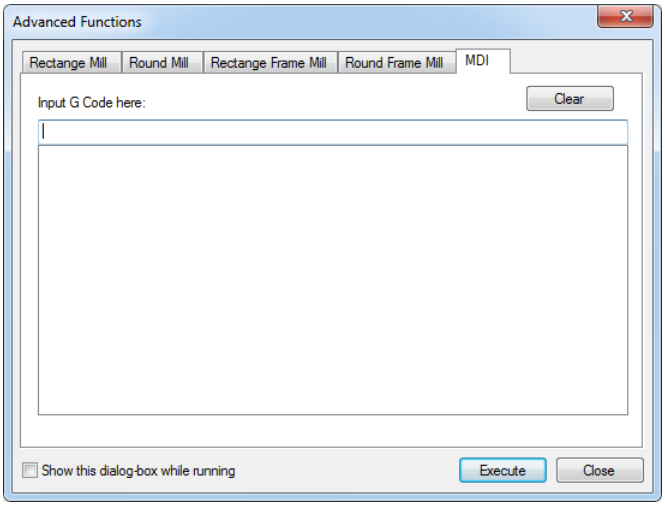


Fig. 4-4 "Advanced Functions" Dialog Box in NcStudio V8

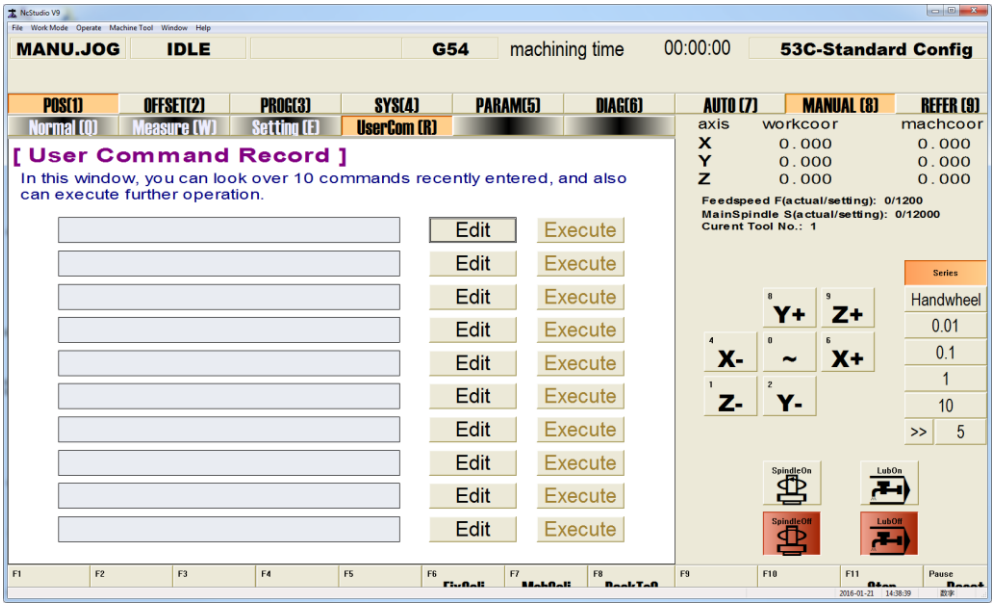


Fig. 4-5 [UserCom] interface in Manual Mode of NcStudio V9

6) Set inverter parameters to make the inverter work under 0~10V analog voltage control mode. Spindle ON/OFF adopts forward rotation terminal control mode. Press down the [Spindle Start] button in the software, and observe in the I/O window whether the color of signal dot in front of "Spindle" turns green, on the terminal board whether the green output indicator LED beside the corresponding relay becomes brightening, and whether the spindle starts to rotate. If the spindle does not rotate, please examine the connection of the inverter. Adjust the spindle speed in the software and the actual spindle speed should be changed correspondingly; otherwise, examine the connection and the parameters setting of the inverter. If the spindle rotates in a wrong direction, change the connection between the spindle and inverter: usually, there are three wires connected with the spindle. Exchanging any two of them will alter the spindle rotation direction.

7) Set subdivision value of stepping motor driver; generally, the larger the subdivision value is, the higher the resolution will be. But if the subdivision value is too large, it will affect the maximum feed rate. Generally speaking, regarding the pulse equivalent of a mold machine, 0.001mm/p (the corresponding maximum feed rate is 9600mm/min) or 0.0005mm/p (the corresponding maximum

feed rate is 4800mm/min) can be taken into consideration; for users who are not very critical of the accuracy, pulse equivalent can be set a litter larger, such as 0.002mm/p (the corresponding maximum feed rate is 19200mm/min) or 0.005mm/p (the corresponding max. feed rate is 48000mm/min). For a two-phase stepping motor, the computational method of pulse equivalent is as right: pulse equivalent =screw pitch ÷ subdivision value ÷ 200.

8) Move the machine tool manually to make sure the correctness of moving direction of each axis. Note that NcStudio adopts “right hand” coordinate system. For X-axis, right movement is the positive direction; for Z-axis, upward movement the positive direction; while the positive direction of Y-axis is to move away from the operator (if the movement of Y-axis is the movement of worktable, its positive direction is the worktable moving towards the operator). If the direction is not correct, alter the axis direction in the system parameters or the relative parameters of servo driver. If Z-axis has brake, check the relative wiring of brake and the relative parameters of servo driver before Z-axis starts to move for the first time. After confirmation, move Z-axis in jog mode, and observe the response of Z-axis, making sure the brake can be opened normally.

9) Examine whether the value of electronic gear matches with that of pulse equivalent. Make a mark on any axis of the machine tool and set this marked point as the workpiece zero. Drive this marked axis to move a fixed distance by direct command input, jog or handwheel, and so on. Measure the actual moving distance with a vernier caliper and check whether the result is equal to the distance showed in the software.

10) Set the worktable stroke in the manufacturer parameters according to the actual size of the machine tool to enable software limit function. The password of manufacturer parameter is “ncstudio”.

11) Set “Back to Machine Zero” parameter in manufacturer parameters according to the installation position of home switches of the three axes. After correct setting, perform the “Back to Machine Zero” function under the menu “Operate”. At first, home a single axis. Home the other two axes on condition that the moving direction of the first axis is correct; otherwise, stop homing and revise “The Direction of Backing to Machine Zero” parameter in manufacturer parameters until all axes can return to the machine zero.

12) Start-up speed: it means the maximum start-up speed of a stepping motor from “0” speed without acceleration. Reasonable parameter setting will greatly improve machining efficiency and can avoid low-speed stage of poor motion feature of a stepping motor. But if the parameter is set too large, the machine tool may be stagnated. Therefore, the parameter setting should be feasible. Usually, start-up frequency parameter is included in ex-factory parameters of motor, but this value may be changed after the assembly of the machine tool; normally it will decrease, especially when the machine tool runs with load. All in all, you’d better refer to the default motor parameters and your actual measurement before setting this parameter.

13) Axial acceleration: it is used to describe the acceleration / deceleration ability of a single axis, in mm/s^2. The value is determined by the physical characteristic of the machine tool, such as quality of movement part, torque, resistance, cutting load of feed-motor, and so on. The larger the value is, the less time spent in the process of acceleration / deceleration will be, and the higher the efficiency will be. Generally, for a stepping motor system, the value is between 100 and 500; for a servo motor system, the value is between 400 and 1200. Set the value smaller at the beginning;

make the machine tool perform various typical movements for a period of time, and carefully observe it; when there is no abnormal situation, increase the value gradually; otherwise, decrease the value and reserve 50% ~ 100% insurance allowance.

14) Turning acceleration: it is used to describe the acceleration/deceleration ability in synchronized motion of multi-axis, in mm/s^2. The value limits the maximum speed of the machine tool in circular movement. The larger this value is, the higher the maximum allowable speed on circular movement of the machine tool will be. Generally, for a stepping motor system, the value is between 400 and 1000; for a servo motor system, the value is between 1000 and 5000; for a heavy machine tool, the value should be smaller. Set the value smaller at the beginning; make the machine tool perform various typical movements for a period of time, and carefully observe it; when there is no abnormal situation, increase the value gradually; otherwise, decrease the value and reserve 50% ~ 100% insurance allowance.

Usually, given the drive ability of stepping motor, frication of machine assembly, and endurance capacity of mechanical components, limit the maximum speed of the three axes in actual using by modifying the max. speed of each axis in manufacturer parameters.

15) Set the parameter of auto lubrication (set a value smaller, such as once every 5 seconds). Observe if auto lubrication is executed correctly. If so, set it according to the actual need.

If there is any problem in the running of the machine tool, please check every part carefully according to the steps above of the whole machine debugging.

4.2 Pulse Test

Examine if any pulse is lost. Direct method: mark a little dot on the surface of a workpiece blank with a dagger; set this point as the workpiece zero; lift up Z-axis; set the coordinate of Z-axis as 0; repeatedly move the machine tool, for example, run a typical procedure with no tools (including synchronized movement of the three axes is much better), pause or stop during machining permitted; and then back to the workpiece zero; descend Z-axis slowly; observe whether the knifepoint matches with the marked dot. If deviation exists, check the type of pulse signal received by the stepping motor driver and the connection between the terminal board and the driver. If stagnation or step missing still exists, please turn to step 13, 14 and 15 to adjust parameters.

5 Software License Agreement

Important—Read Carefully before Using This Product:

The term “Software Product” includes all copies of the licensed software and its documentation. This license agreement is a legal agreement between You (either an individual, a legal entity or any affiliated companies or other entities) and Weihong Electronic Technology Co., Ltd. (hereinafter referred to as Weihong Company). By installing, copying, or otherwise using the Software Product, you agree to be bound by the terms and conditions of this license. Unless otherwise stated in this agreement, you shall not use, copy, revise, rent, or transfer the Software product or any part of the Software Product for any other purposes.

Description of Further Rights and Restrictions:

1) You may install for use one copy of the Software Product on a single machine;
2) You may make a copy of the Software Product for archive or backup purposes and the copy is to be used on this machine only;
3) You may transfer the Software Product and the license agreement to a third party, provided that the third party accepts the terms and conditions stated in this agreement, with prior express permission from Weihong Company;
4) When transfer confirmed, you shall transfer all the copies of the original documents and the supplementary documents to the third party or destroy all the copies un-transferred.
5) You can use the Software Product on a network server or intranet server only if it is stipulated in explicit terms that you are allowed to use the Software Product on a network server or intranet server, or you have purchased license for each node and terminal using the Software Product;
6) You may NOT sublicense, assign or transfer the license agreement;
7) You may NOT or direct any third party to reverse engineer, decompile or disassemble the Software Product;
8) You may NOT copy or transfer the Software Product or any part of the Software Product unless otherwise expressly stated in this agreement;
9) The license agreement shall be terminated automatically upon you transfer the Software Product or copies of all or part of the Software Product to a third party.

Intellectual Property Rights Notice:

The Software Product and all intellectual property rights therein (including but not limited to any all copyrights, patents, trademarks, and publicity rights) are owned by Weihong Company. The Software Product is protected for Weihong Company on the basis of copyright law and international treaty provisions as well as on the basis of other laws and agreements regarding intellectual property. You are not allowed to remove the copyright statement made in the Software Product, and guarantee that you shall copy the copyright statement in all copies of the Software Product or of any part of the Software Product. You are obliged to stop any form of illegal copying of the Software Product and

accompanying materials.

After-sales Guarantee:

Weihong Company guarantees that for 90 days from the date of shipment the software carrier will be free from defects in materials and workmanship. When such a defect has been confirmed, our only responsibility is to replace the software carrier. This remedy is your exclusive remedy. This after-sales guarantee is invalid for any carrier defect caused by accidents, abuses or maloperation. The replaced software carrier enjoys the remaining guarantee time of the original software carrier or of a 30-day guarantee time, whichever is longer.

Except as the after-sales guarantee made above, the Software Product does not enjoy any other form of after-sale guarantee.

Limitation of Liability:

The above guarantee, whether made explicitly or by implication, constitutes the entire contents of the guarantee, including guarantee for the commerciality and applicability of special application aim. Whether you follow other terms in this agreement or not, Weihong Company, as well as its agents and sales staff, will not be responsible for any profits loss, availability loss, business break-off or any forms of indirect, special, accidental or inevitable damage or claim made by any third party, generated from the using of the Software Product, even if Weihong Company has been informed of the possible occurrence of such events in advance.

Termination:

This license may be terminated by Weihong Company at any time once you violate any terms or conditions made in this agreement. Once the license is terminated, you are obliged to destroy all the copies of the Software Product or return them to Weihong Company.

Applicable Law:

Copyright Law, Regulations for the Protection of Computer Software, Patent Law and other relevant laws and regulations.

Now, we affirm that you have already read through this agreement and understood it thoroughly and agreed to comply with all of the terms and conditions of this agreement strictly.

Weihong Electronic Technology Co., Ltd.